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DATA SHEET

TEA1085; TEA1085A
Listening-in circuit for line-powered telephone sets

Preliminary specification
File under Integrated Circuits, IC03A

March 1992

Philips
Semiconductors

PHILIPS

Listening-in circuit for line-powered telephone sets

TEA1085; TEA1085A

FEATURES

- Internal supply

  optimum current split-up
  - low constant current (adjustable) in transmission IC
  - nearly all line current available for listening-in
  adjustable supply voltage

- Loudspeaker amplifier

  dynamic limiter providing low distortion and the highest possible output power
  SE or BTL drive for loudspeaker volume control by potentiometer and/or logic inputs (e.g. microcontroller drive)
  fixed gain of 35 dB

- Larsen level limiter

  low sensitivity for own speech due to 3rd-order filter and attack delay
  adjustable voltage thresholds

- Power down input
- MUTE input

  TEA1085/TEA1085A
  - clickfree switching between listening-in mode and standby mode

  TEA1085
  - toggle function
  - start-up in standby condition

  TEA1085A
  - logic level input

GENERAL DESCRIPTION

The TEA1085 and TEA1085A are bipolar ICs which have been designed for use in line-powered telephone sets and provide a listening-in facility for the received line signal via a loudspeaker. Nearly all the line current can be used for powering the loudspeaker.
The circuits incorporate a supply circuit, loudspeaker amplifier dynamic limiter, MUTE circuit, power-down facility and logic inputs for gain setting. The devices also incorporate a Larsen Level Limiter to reduce howling effects.
The ICs are intended for use in conjunction with a transmission circuit of the TEA1060 family.

ORDERING INFORMATION

EXTENDED TYPE NUMBER	PACKAGE			
	PINS	PIN POSITION	MATERIAL	CODE
TEA1085/TEA1085A	24	DIL	plastic	SOT101B(1)
TEA1085T/TEA1085AT	24	SO24	plastic	SOT137A(2)

Notes

1. SOT101-1; 1998 Jun 18.
2. SOT137-1; 1998 Jun 18.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
I_{SUP}	input current range		4	–	120	mA
V_{BB}	stabilized supply voltage		–	3.6	–	V
I_{SUP}	current consumption	PD = HIGH	–	55	–	µA
G_v	voltage gain loudspeaker amplifier					
		SE	–	35	–	dB
		BTL	–	41	–	dB
ΔG_v	maximum gain reduction with logic inputs (3 steps)		–	18	–	dB
I_{SUP}	minimum input current					
		P_{OUT} = 20 mW typ. into 50 Ω SE	–	15	17	mA
		P_{OUT} = 40 mW typ. into 50 Ω BTL	–	–	32	mA
$t_{ad(RMS)}$	Larsen limiter attack delay time V_{DTI} jumps from 0 to ≥ 100 mV (RMS value)		100	–	200	ms
$V_{DTI(RMS)}$	Larsen limiter threshold level	Larsen mode	–	7	–	mV
G_v	Larsen limiter preamplifier gain setting range		30	–	52	dB
T_{amb}	operating ambient temperature range		−25	–	+75	°C

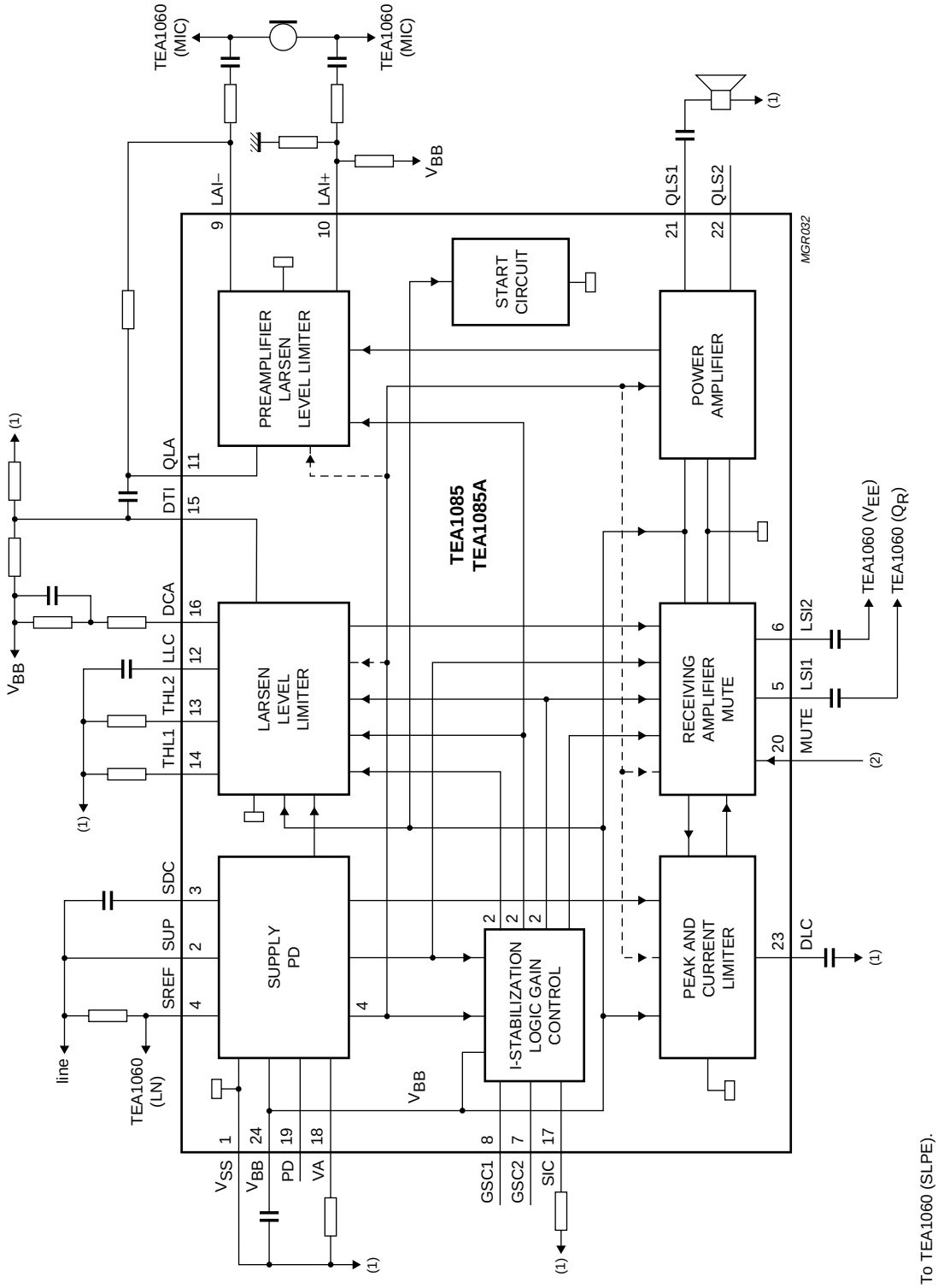


Fig.1 Block diagram.

(1) To TEA1060 (SLPE).
(2) See Fig.16.

PIN CONFIGURATION

SYMBOL	PIN	DESCRIPTION
V_{SS}	1	negative supply
SUP	2	positive supply
SDC	3	supply amplifier decoupling
SREF	4	supply reference input
LSI1	5	loudspeaker amplifier input 1
LSI2	6	loudspeaker amplifier input 2
GSC2	7	logic input 2 for gain select
GSC1	8	logic input 1 for gain select
LAI–	9	Larsen limiter preamplifier inverting input
LAI+	10	Larsen limiter preamplifier non-inverting input
QLA	11	Larsen limiter preamplifier output
LLC	12	Larsen limiter capacitor
THL2	13	Larsen limiter residual threshold level
THL1	14	Larsen limiter attack delay threshold level
DTI	15	Larsen limiter detector input
DCA	16	Larsen limiter detector current adjustment
SIC	17	Larsen limiter current stabilizer
VA	18	V_{BB} voltage adjustment
PD	19	power-down input
MUTE	20	MUTE input
QLS1	21	loudspeaker amplifier output 1
QLS2	22	loudspeaker amplifier output 2
DLC	23	dynamic limiter capacitor
V_{BB}	24	stabilized supply decoupling

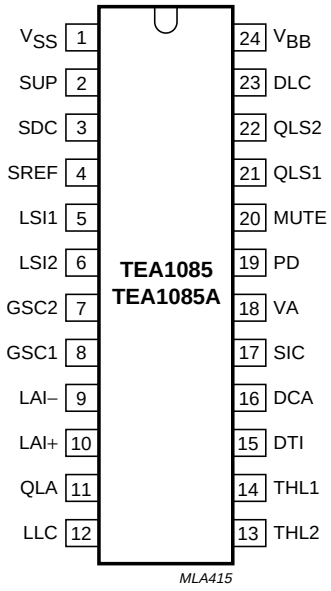


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

Figure 1 illustrates a block diagram of the TEA1085/TEA1085A with external components and connections to the transmission IC.

The TEA1085/TEA1085A are bipolar ICs which have been designed for use in line-powered telephone sets and provide a listening-in facility for the received line signal via a loudspeaker. Nearly all the line current can be used for powering the loudspeaker.

The loudspeaker amplifier consists of a preamplifier, to amplify the earpiece signal from the transmission circuit and, a double push-pull output stage to drive the loudspeaker in the BTL (bridge tied load) or SE (single ended) configuration. The gain of the preamplifier is controlled by a dynamic limiter which prevents high distortion of the loudspeaker signal. This is achieved by preventing clipping of the loudspeaker signal, with respect to the supply voltage, and at too low supply current. Two logic inputs can be used to reduce the gain in 3 steps.

Because of acoustic feedback from the loudspeaker to the microphone, howling signals (Larsen effect) can occur on the telephone line and in the loudspeaker. When the Larsen signal exceeds a voltage and time duration threshold the Larsen level limiter (LLL) will reduce the Larsen signal to a low level within a short period of time by reducing the gain of the receiving preamplifier. This is achieved by using the microphone signal as an input signal which is processed in the LLL via a preamplifier and 3rd-order filter.

The MUTE input can be used to enable or disable the loudspeaker amplifier.

The MUTE function of the TEA1085 has a toggle input to permit the use of a simple push-button switch.

The MUTE function of the TEA1085A has a logic input to operate with a microcontroller.

By activating the power-down input the current consumption of the circuit will be reduced, this enables pulse dialling or flash (register recall).

An internal start circuit ensures normal start-up of the transmission IC and start-up of the listening-in IC in the standby mode.

The TEA1085/TEA1085A are intended for use in conjunction with a member of the TEA1060 family and should be connected between LINE and SLPE of the transmission IC. The transmission characteristics (impedance, gain settings, for example) are not affected. The interconnection between the two ICs is illustrated in Fig.3.

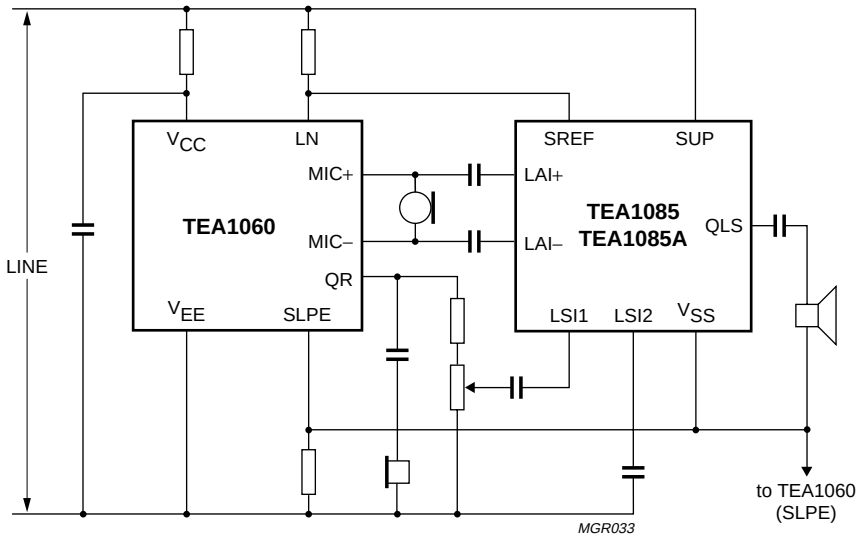
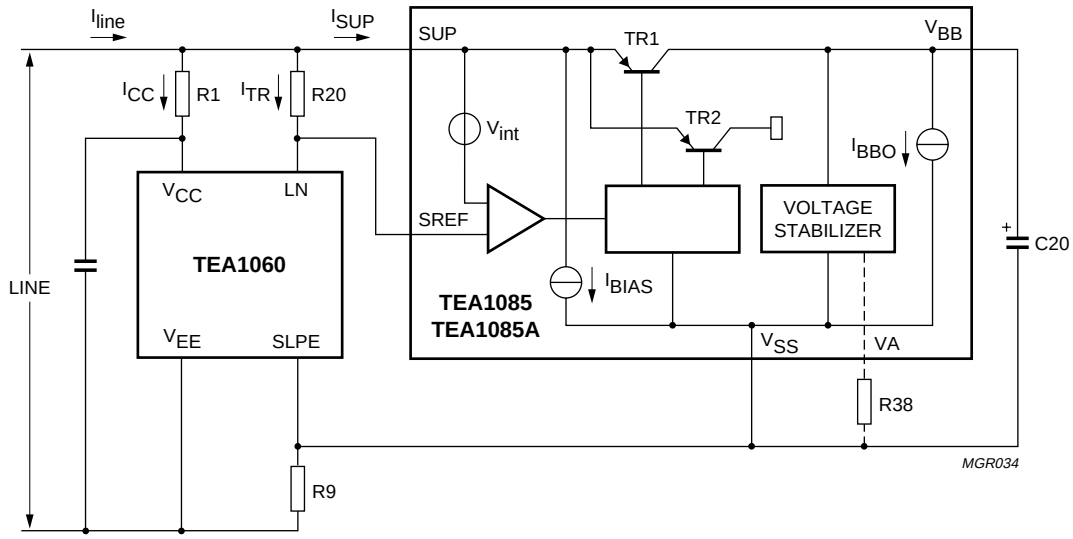


Fig.3 Interconnection of the TEA1085/TEA1085A with the TEA1060.

Supply; SUP, SREF, V_{BB}, V_{SS} and VA

The line current is divided into I_{TR} for the TEA1060 and I_{SUP} for the TEA1085/TEA1085A. The supply arrangement is illustrated in Fig.4.



I_{TR} is constant: $I_{TR} = V_{int} / R20$; $I_{SUP} = I_{line} - I_{CC} - I_{TR}$

Fig.4 Supply arrangement.

Where:

V_{int}	is an internal temperature compensated reference voltage with a typical value of 315 mV between SUP and SREF
R20	is a resistor between SUP and SREF
I_{CC}	is the internal current consumption of the TEA106X (≈ 1 mA)

A practical value for R20 is 150 Ω. This value of resistance produces a value for I_{TR} = 2 mA and $I_{SUP} = I_{line} - 3$ mA.

The TEA1085/TEA1085A stabilizes its own supply voltage at V_{BB}. Transistor TR1 provides the supplies for the internal circuits. TR2 is used to minimize the signal distortion on the line by momentarily diverting the input current to V_{SS} whenever the instantaneous value of the voltage V_{SUP} drops below the supply voltage V_{BB}. V_{BB} is fixed to a typical value of 3.6 V but can be increased by means of an external resistor (R38) connected between VA and V_{SS} or decreased by connecting this resistor between VA and V_{BB}. The minimum level on V_{BB} is restricted to 3.0 V; the level of the V_{BB} limiter is also affected (see application report for further information). The supply at V_{BB} is decoupled by a 470 μF capacitor.

The DC voltage ($V_{SUP} - V_{SS}$) is determined by the transmission IC ($V_{LN-SLPE}$); thus:
$V_{SUP} - V_{SS} = V_{LN-SLPE} + V_{int}$.
The minimum DC voltage that can be applied to this input is $V_{BB(max)} + 0.4$ V.

Where: $V_{BB(max)}$ is the worst case supply voltage (this depends on the setting of R38, which is connected between VA and V_{SS}).

The internal current consumption of the TEA1085/TEA1085A (I_{SUP0}) is typically 4.2 mA (where $V_{SUP} - V_{SS}$ = 4.5 V, MUTE off). Thus the current available for powering the loudspeaker is $I_{SUP} - I_{SUP0}$.
The current I_{SUP0} consists of a bias current of ≈ 0.4 mA for the circuitry connected to SUP and current I_{BB0} of ≈ 3.8 mA which is used for the circuitry connected to V_{BB} (see Fig.4).

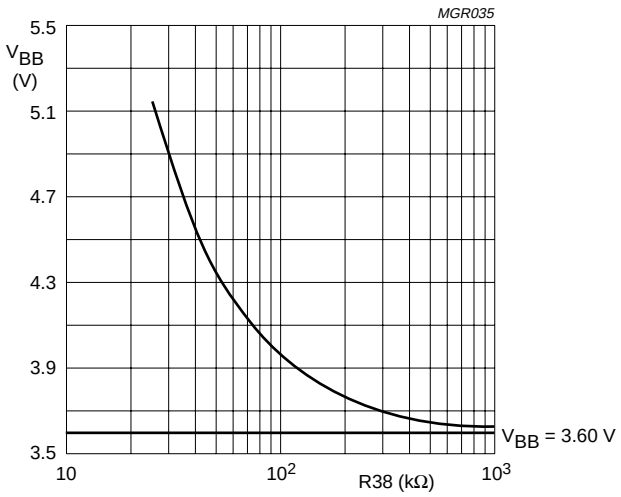


Fig.5 Stabilized supply voltage as a function of R38.

Supply amplifier stability (SDC) pin 3

To ensure stability of the TEA1085/TEA1085A, in combination with a transmission IC of the TEA1060 family, a 47 pF capacitor connected between SDC and SUP and a 150 μH coil connected between SUP and the positive line terminal (Fig.16) is required.

Loudspeaker amplifier (LSI1/LSI2 and QLS1/QLS2) pins 5/6, 21/22

The TEA1085/TEA1085A have symmetrical inputs at LSI1 and LSI2. The input signal is normally taken from the earpiece output of the transmission circuit via a resistive attenuator (see Fig.3). The amount of attenuation must be chosen in accordance with the receive gain of the transmission IC (which depends on the sensitivity of the earpiece transducer). The maximum input signal level is 450 mV(RMS) at T_{amb} = +25 °C.
The outputs QLS1 and QLS2 can be used for single ended drive (SE) or bridge tied load drive (BTL). The output stages have been optimized for use with a 50 Ω loudspeaker (e.g. Philips type AD2071).
The gain of the amplifier is fixed to ≈ 35 dB for the SE drive and ≈ 41 dB for the BTL drive (when the inputs for logic control are left open-circuit or are connected to V_{SS}).
The volume control can be obtained by using a potentiometer at the input and/or by the logic control function.

Logic gain control (GSC1 and GSC2) pins 7 and 8

The logic inputs GSC1 and GSC2 can be used to reduce the gain of the loudspeaker amplifier by means of the logic gain control function in 3 steps of 6 dB.

Table 1 Data for microcontroller drive of logic inputs

GSC2	GSC1	gain (dB)	gain reduction (dB)
0	0	35	0
0	1	28.7	6.3
1	0	22.2	12.2
1	1	17	18

Where:

0 = connection to V_{SS} or left open-circuit
1 = applying a voltage ≥ V_{SS} + 1.5 V

Dynamic limiter (DLC) pin 23

To prevent distortion of the signal at the loudspeaker outputs the gain of the amplifier is reduced rapidly when:

- the peaks of the signal at the loudspeaker outputs exceed an internally determined threshold (voltage limiter)
- the DC current into SUP is insufficient (current limiter)
- the voltage at V_{BB} decreases below an internally determined threshold, typically 2.9 V (V_{BB} limiter)

The time in which the gain reduction is effected is the 'attack time'; this is very short in the first and third instance and relatively long in the second instance. The circuit will remain in the gain-reduced condition until the peaks of the output signal remain below the threshold level. The gain will then return to a nominal level after a time determined by the capacitor connected to DLC (release time).

MUTE input (MUTE) pin 20; TEA1085A

This MUTE is provided with a logic input to operate with a microcontroller for instance.
The loudspeaker amplifier is disabled when the MUTE input is LOW (connected to V_{SS} or open input). A HIGH level at the MUTE input enables the amplifier in the listening-in mode.

MUTE input (MUTE) pin 20; TEA1085

The MUTE function is provided with a toggle input and is designed to switch between the standby condition and the listening-in condition on the rising edge of the input MUTE signal (see Fig.6).
In the basic application the MUTE input must be LOW (connected to V_{SS}). A simple push-button can be used to operate the MUTE toggle (see Fig.7). Debouncing can be realized by means of a small capacitor connected between MUTE and V_{SS}.
An internal start circuit ensures that the circuit always starts up in the standby condition.

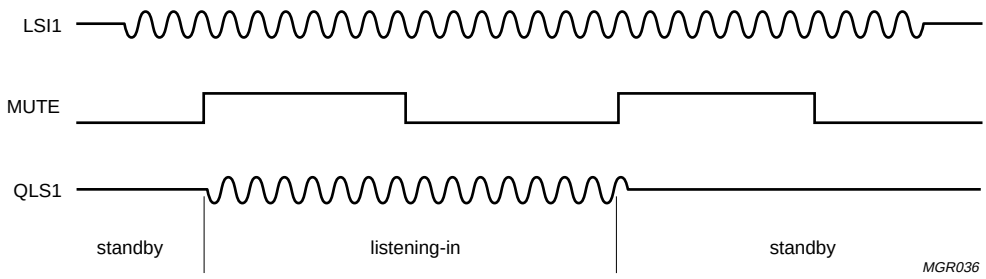
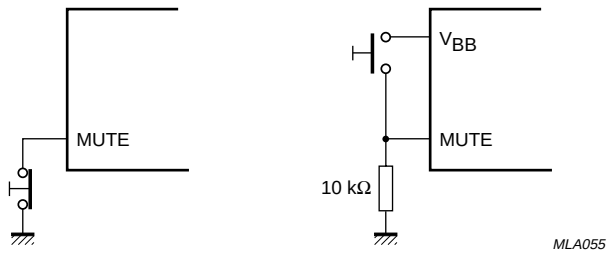


Fig.6 Mute toggle function of the TEA1085.



(a) Break contact. (b) Make contact.

Fig.7 Mute switch alternatives with the TEA1085.

Power down input (PD) pin 19

During pulse dialling or register recall (timed loop break) the telephone line is interrupted, thereby breaking the supply to the transmission and listening-in circuits. The capacitor connected to V_{BB} provides the supply for the listening-in circuit during the supply breaks.
By making the PD input HIGH during the loop break the requirement on the capacitor is eased and, consequently, the internal (standby) current consumption I_{BBO} (Fig.4) at V_{BB} is reduced from 3.8 mA to 400 μA typical. So that the transmission circuit is not affected transistors TR1 and TR2 are inhibited and the bias current is reduced from ≈ 0.4 mA to ≈ 55 μA with V_{SUP} = 4.5 V in the following equation:

$I_{SUP(PD)} = I_{BIAS(PD)} = (V_{SUP} - 2V_d) / Ra$

(where $4.2\ V < V_{SUP} < V_{BB} + 3\ V$)

$2V_d$ = the voltage drop across 2 internal diodes (≈ 1.3 V)
Ra = an internal resistor of typical 60 kΩ

Larsen limiter current stabilizer (SIC) pin 17

A current reference is set by resistor R36 between SIC and V_{SS}. The preferred value is 120 kΩ. The internal reference current is given by the following equation:

$I_{SIC} = 1.25 / R36$; when R36 = 120 kΩ, I_{SIC} = 10.5 μA

Changing the value of R36 will affect the timing of the Larsen level limiter system.

Larsen limiter preamplifier (LAI1/LAI2 and QLA) pins 9/10 and 11

This circuit amplifies the microphone signal to a level suitable for the Larsen limiter detector. The gain is set by external components (see Fig.8).
Normally the gain is set to the same level as the microphone amplifier of the transmission circuit, this ensures that the output signal level at output QLA is equal to the line signal level.

The gain between QLA and the microphone input is given by the following equation (the high-pass filter is not taken into account):

$A_{pre} = V_{QLA} / V_M = R29 / R26$; in the basic application R25 = R26 = 10 kΩ

The gain can be adjusted between 30 dB (R29 = 316 kΩ) and 52 dB (R29 = 4 MΩ). The impedance result of R28 and R27 in parallel must be equal to R29 (e.g. R27 = R28 = 2 × R29).

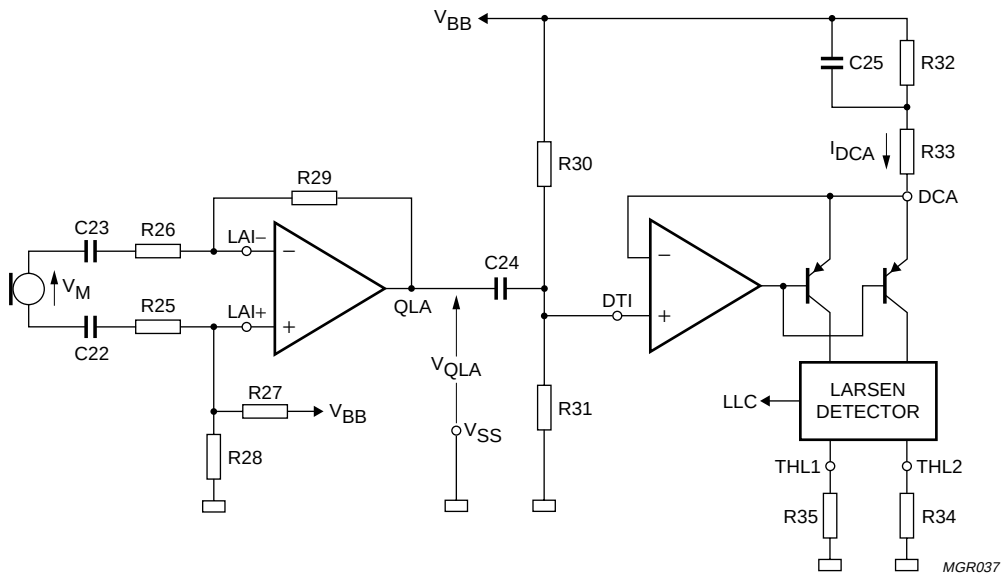


Fig.8 Larsen limiter preamplifier and voltage/current converter.

Larsen limiter detector (DTI and DCA) pins 15 and 16

The QLA output signal is AC coupled to the detector input DTI. DTI is biased by potential divider R30 and R31. The voltage applied to DTI of the Larsen level limiter is converted into a current for further processing in this circuit. Current adjustment is achieved using the network connected between DCA and V_{BB} (see Fig.8).

The equation for DC current is:

$$I_{DCA} = \frac{R30}{R30 + R31} \times V_{BB} \times \frac{1}{R32 + R33}$$

The equation for AC current is:

$$i_{DCA} = \frac{V_{DTI}}{R33} \text{ for } f > \frac{1}{2}\pi \text{ R33 C25}$$

In the basic application:

R30 = 100 kΩ, R31 = 220 kΩ, R33 = 500 Ω, R32 = 100 kΩ and C25 = 330 nF

This results in I_{DCA} = 11 μA and the equation:

$$\frac{i_{DCA}}{V_{DTI}} = 2 \text{ (mA/V)}$$

High-pass filter

A third order high-pass filter is created between the microphone input voltage and the current flowing into DCA. The cut-off frequencies (see Fig.9) of the three sections are:

$$f1 = \frac{1}{2\pi R_{eg} C24} \text{ where } R_{eq} = \frac{R30 \times R31}{R30 + R31}$$

$$f2 = \frac{1}{2\pi R33 C24}$$

$$f3 = \frac{1}{2\pi R26 C23} = 1/(2\pi R25 C22)$$

Where: R25 = R26 and C22 = C23

The filter reduces the sensitivity of the system to own speech.
Normal speech is in the frequency range 300 Hz to 3400 Hz, however, the Larsen signal normally occurs at a frequency > 3 kHz.
With the component values as used in the basic application (see Fig.16); f1 = 500 Hz, f2 = 1 kHz and f3 = 3 kHz

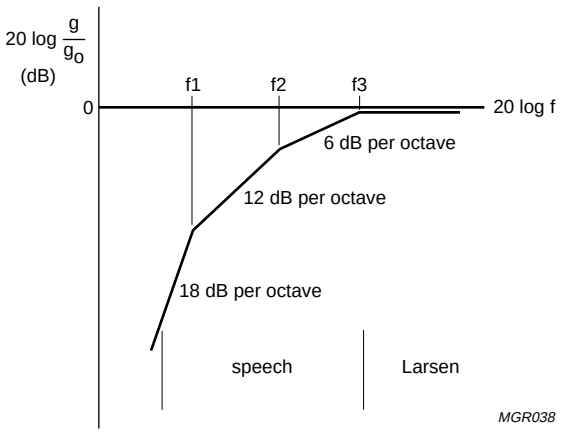


Fig.9 Third-order high-pass filter.

Where: $g = \frac{i_{DCA}}{V_m}$ $g_o = \frac{A_{pre}}{R33}$

Larsen limiter capacitor (LLC) pin 12

A 1 μF capacitor (C26) is connected externally between V_{SS} and LLC to determine the attack and release timing of the Larsen level limiter in the listen-in and Larsen mode. The timing is also dependent on the value of the resistor connected between SIC and V_{SS}.

Larsen level limiter threshold (THL1 and THL2) pins 13 and 14

When the signal at DTI exceeds the first threshold level the capacitor connected to LLC will start to discharge. The first threshold level is determined by the value of the resistor, R35, connected to THL1 and V_{SS}. The amount of discharge of C26 depends on how much the level of the signal at DTI exceeds the first threshold level (for normal speech the discharge is small).
The Larsen effect is generally defined as a signal level of ≥ 100 mV(RMS), on line, for a period of more than 100 ms. The Larsen signal must be reduced to a low level within 200 ms. For Larsen signal levels (f > f3 in Fig.9) of ≥ 100 mV(RMS) at DTI and, with the component values of Fig.16, the system will switch from the listen-in mode to the Larsen mode in a time period of 100 ms to 200 ms; consequently, the initial Larsen effect will last only for a short period of time.

This reaction time is the 'attack delay time' and ensures minimum sensitivity of the system for own speech.

The first threshold level at DTI is determined by the equation:

$$V_{DTI1} = \left(\frac{1.25}{R25} - \frac{I_{DCA}}{2}\right) \times 2 \times R33 \quad (\text{if } f > f3 \text{ in Fig.9})$$

Where: I_{DCA} = the DC current into DCA

With the component values given in Fig.16, I_{DCA} = 11 μA thus V_{DTI1} = 18.8 mV.

Listen-in mode

During normal speech the discharge of the capacitor connected to LLC is not sufficient to reach the threshold level whereby the system switches to the Larsen mode. This is because normal speech is not continuous, the discharge of C26 is slow (attack delay) and the charge is fast.
The slope of V_{LLC} during charge is given in the equation:

$$S_{1i} = \frac{\Delta V_{LLC}}{\Delta_\tau} = \frac{1.25}{C26 \times R36} \quad (V/s)$$

With C26 = 1 μF and R36 = 120 kΩ this results in S_{1i} = 10 V/s.

Discharge of the capacitor at LLC occurs when the signal at DTI exceeds V_{DTI1}, thus for a continuous signal at DTI the attack delay time t_{ad} (see Fig.10) is determined by the equation:

$$t_{ad} = \frac{C26 \times R36}{2 \times (3 \times k - 1)}$$

Where $k = t_1 / T$

The duty cycle is determined by the time in which the first threshold level (V_{DTI1}) is exceeded by the signal level at DTI (see Fig.11) thus for large signals; $k \leq 0.5$.
With the component values given in Fig.16; $k \geq 0.457$ for signals ≥ 100 mV(RMS).
Consequently 120 ms ≤ t_{ad} ≤ 160 ms, for V_{DTI} ≥ 100 mV(RMS)

Larsen mode

After the 'attack delay time' the circuit switches from the listen-in mode to the Larsen mode. The gain of the loudspeaker amplifier is reduced quickly to a value (t_{LAa} = Larsen attack time, see Fig.10) whereby the residual Larsen signal is determined by a second threshold level. This level can be set by resistor R34 connected between THL2 and V_{SS}. The second threshold level must always be selected at a lower level than the first threshold level thus R34 > R35.
The time taken to effect gain reduction is very short. In the Larsen mode the circuit acts as a dynamic limiter with peak detector and regulates the gain so that the signal level at DTI is determined by the second threshold level V_{DTI2}.
The second threshold level at DTI is determined by the equation:

$$V_{DTI2} = \left(\frac{1.25}{R34} - \frac{I_{DCA}}{2}\right) \times 2 \times R33 \quad (\text{if } f > f3 \text{ in Fig.9})$$

Where: I_{DCA} = the DC current into DCA

With the component values given in Fig.16, V_{DTI2} = 6.9 mV.

The charge current in the Larsen mode is reduced to half the charge current in the listen-in mode.

The slope of V_{LLC} during charge (see Fig.10) is given in the equation:

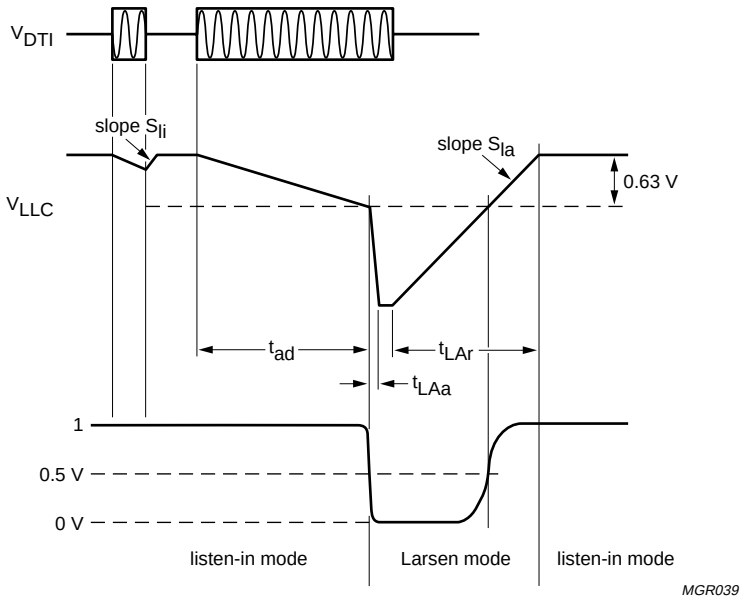
$$S_{la} = \frac{\Delta V_{LLC}}{\Delta_\tau} = \frac{1.25}{2 \times C26 \times R34} \, (V/s)$$

Where: C26 = 1 μF and R36 = 100 kΩ, S_{la} = 5 V/s

When the Larsen effect stops (total open-loop gain < 1) the gain of the loudspeaker amplifier will return to its normal value in a time period known as the 'Larsen release time' (t_{LAr}). This time period is determined by capacitor C26 connected to LLC and resistor R36 connected to SIC.

Where: C26 = 1 μF and R36 = 120 kΩ, t_{LAr} = 250 ms

In practice the choice of the threshold levels (determined by R35 and R34) depends on the sensitivity of the microphone and loudspeaker, the send and receive gains, sidetone suppression and the acoustical properties which are determined by the cabinet of the telephone set.

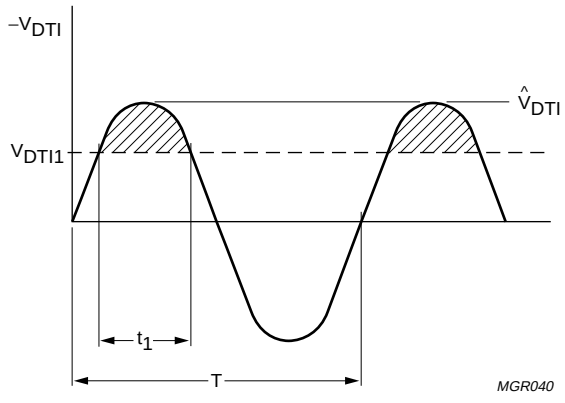


Where:

Change of receive gain $= \frac{G_v}{G_{vo}}$

Nominal receive gain = 20 log G_{vo} = 35 dB

Fig.10 Dynamic behaviour of Larsen limiter (in open-loop condition).



Where:

$k = \frac{t_1}{T}$

$$k = 0.5 - \frac{\arcsin\left(\frac{V_{DTI1}}{\hat{V}_{DTI}}\right)}{\pi}$$

Fig.11 Definition of duty cycle k.

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134)

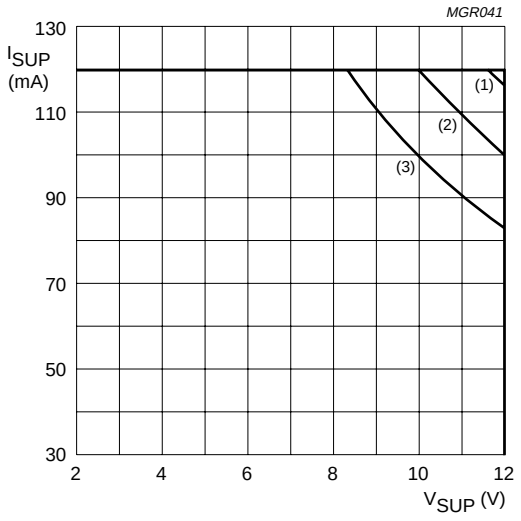
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{SUP}	positive supply voltage				
	continuous		–	12	V
	during switch-on or line interruption		–	13.2	V
	repetitive supply voltage from 1 ms to 5 s	with 12 Ω current limiting resistor in series with supply	–	28	V
V_{SREF}	supply reference voltage		V_{SS} − 0.5	V_{SUP} + 0.5	V
V_n	voltage on all other pins		V_{SS} − 0.5	V_{BB} + 0.5	V
I_{SUP}	supply current				
	TEA1085/TEA1085A	see Fig.12	–	120	mA
	TEA1085T/TEA1085AT	see Fig.13	–	120	mA
P_{tot}	total power dissipation	T_{amb} = 75 °C; T_j = 125 °C			
	TEA1085/TEA1085A		–	1	W
	TEA1085T/TEA1085AT		–	666	mW
T_{amb}	operating ambient temperature range		−25	+75	°C
T_{stg}	storage temperature range		−40	+125	°C
T_j	junction temperature		–	+125	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	THERMAL RESISTANCE
$R_{th\ j\text{-}a}$	from junction to ambient in free air		
	TEA1085/TEA1085A		50 K/W
	TEA1085T/TEA1085AT	note 1	75 K/W

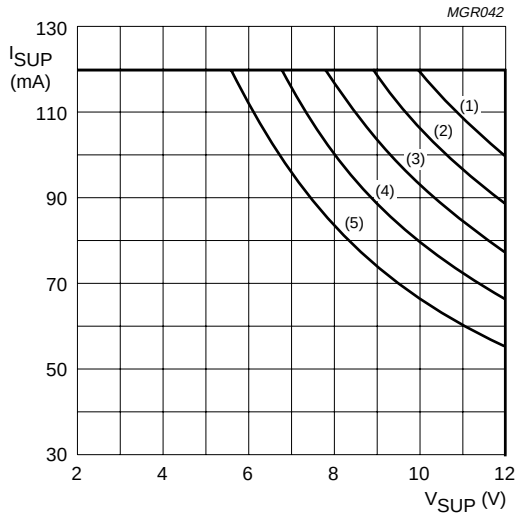
Note

1. Device mounted on a glass epoxy board 40.1 × 19.1 × 1.5 mm.



(1) T_{amb} = 55 °C; P_{tot} = 1.4 W.
(2) T_{amb} = 65 °C; P_{tot} = 1.2 W.
(3) T_{amb} = 75 °C; P_{tot} = 1.0 W.

Fig.12 TEA1085/TEA1085A safe operating area.



(1) T_{amb} = 35 °C; P_{tot} = 1.2 W.
(2) T_{amb} = 45 °C; P_{tot} = 1.07 W.
(3) T_{amb} = 55 °C; P_{tot} = 0.93 W.
(4) T_{amb} = 65 °C; P_{tot} = 0.8 W.
(5) T_{amb} = 75 °C; P_{tot} = 0.666 W.

Fig.13 TEA1085T/TEA1085AT safe operating area.

CHARACTERISTICS

V_{SREF} = 4.2 V; V_{SS} = 0 V; I_{SUP} = 15 mA; V_{SUP} = 0 V(RMS); f = 800 Hz; T_{amb} = 25 °C; PD = LOW; MUTE (TEA1085) = OFF (listening-in mode); MUTE (TEA1085A) = HIGH (listening-in mode); GSC1 = GSC2 = LOW; 50 Ω loudspeaker; no R38; test circuit Fig.14; unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{SUP}	minimum DC input voltage		–	V_{BB} + 0.7	–	V
$V_{SUP-SREF}$	internal reference voltage		275	315	355	mV
V_{BB}	stabilized supply voltage	no R38; I_{SUP} = 15 mA	3.4	3.6	3.8	V
ΔV_{BB}	variation from I_{SUP} = 15 to 120 mA		–	10	–	mV
		R38 = 39.2 kΩ between pins V_{SS} and VA; V_{SREF} = 5.2 V; I_{SUP} = 15 mA	4.2	4.45	4.7	V
$\Delta V_{BB}/\Delta T$	variation with temperature	no R38; I_{SUP} = 15 mA	tbf	–0.2	tbf	V
I_{SUP}	minimum operating current		–	4.2	5.5	mA
THD	distortion of AC signal on SUP	$V_{SUP(RMS)}$ = 1 V	–	0.3	–	%
$V_{no(RMS)}$	noise between SUP and V_{EE}		–	–72	–	dBmp
	current consumption in power-down condition	PD = HIGH				
I_{SUP}		V_{SUP} = 4.5 V	–	55	75	µA
I_{BB}		V_{BB} = 3.6 V	–	400	550	µA
Loudspeaker amplifier inputs LSI1 and LSI2						
$\|Z_i\|$	input impedance					
		single ended	7.5	9.5	11.5	kΩ
		differential	15	19	23	kΩ
G_v	voltage gain with 50 Ω load	I_{SUP} = 15 mA; V_i = 1.8 mV(RMS)				
		single ended	34	35	36	dB
		BTL output	39.9	40.9	41.9	dB
ΔG_v	variation with signal level	I_{SUP} = 50 mA; V_i = 1.8 mV(RMS) and 14 mV(RMS)				
		single ended	–	+0.1	0.4	dB
		BTL output	–	+0.2	0.6	dB
ΔG_v	variation with frequency referred to 1 kHz	f = 300 Hz and 3400 Hz; V_i = 1.8 mV(RMS)				
		single ended	–	± 0.1	–	dB
		BTL output	–	± 0.1	–	dB
ΔG_v	variation with temperature referred to 25 °C	T_{amb} = –25 to +75 °C				
		single ended	–	± 0.4	–	dB
		BTL output	–	± 0.5	–	dB

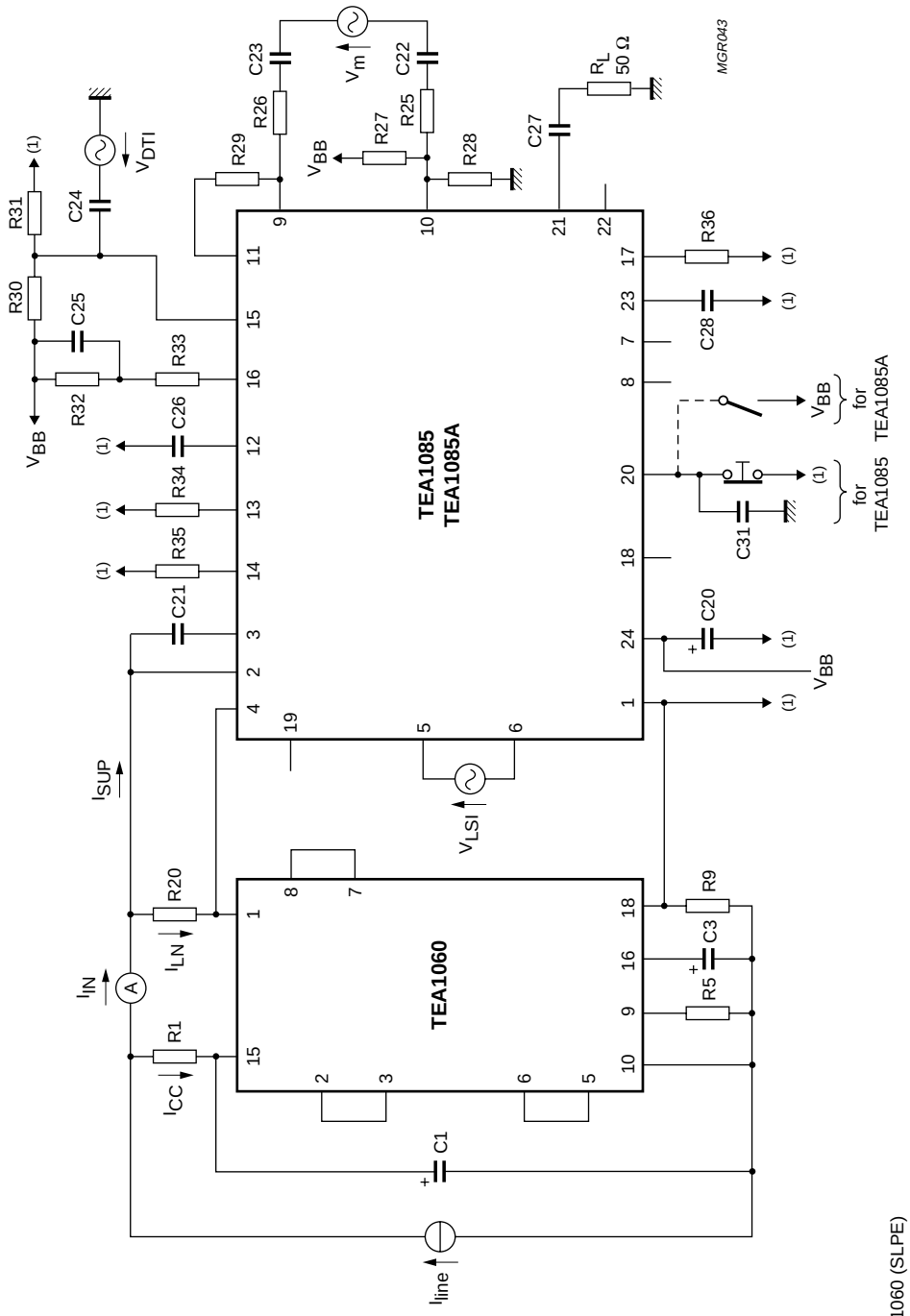
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Loudspeaker outputs QLS1 and QLS2						
$V_{o(p-p)}$	output voltage (peak-to-peak value)	V_i = 22 mV(RMS)				
	single ended	I_{SUP} = 9 mA; note 1	1.2	1.45	–	V
		I_{SUP} = 17 mA; note 2	2.5	2.9	–	V
	bridge tied load	I_{SUP} = 23.5 mA; note 2	2.5	2.9	–	V
		I_{SUP} = 32 mA; note 3	3.5	4.0	–	V
THD	total harmonic distortion	V_i = 22 mV(RMS)				
	single ended	I_{SUP} = 9 mA	–	0.4	2	%
		I_{SUP} = 17 mA	–	0.7	2	%
	bridge tied load	I_{SUP} = 23.5 mA	–	0.4	2	%
$V_{o(p-p)}$	output voltage (peak-to-peak value)	V_i = 22 mV(RMS)				
	single ended	I_{SUP} = 17 mA; $V_{SUP} - V_{EE}$ = 1 V(RMS)	1.75	2.15	–	V
Dynamic limiter						
THD	total harmonic distortion	V_i = 22 mV(RMS) +10 dB				
	single ended	I_{SUP} = 9 mA	–	0.5	10	%
		I_{SUP} = 17 mA	–	1.2	10	%
	bridge tied load	I_{SUP} = 23.5 mA	–	0.6	10	%
t_{att}	dynamic behaviour of limiter attack time; V_i jumps from 10 mV(RMS) to 65 mV(RMS)	single ended load				
	voltage limiter	I_{SUP} = 17 mA	–	2	5	ms
	current limiter	I_{SUP} = 12 mA	–	500	tbf	ms
	V_{BB} limiter	I_{SUP} = 9 mA	–	10	–	ms
t_{rel}	release time; V_i jumps from 65 mV(RMS) to 10 mV(RMS)	I_{SUP} = 17 mA	tbf	75	tbf	ms
V_{BBO}	threshold V_{BB} limiter below which gain reduction starts	I_{SUP} = 9 mA	tbf	2.95	tbf	V
$V_{no(RMS)}$	noise output voltage	1 kΩ between inputs LSI1, LSI2; psophometrically weighted (P53 curve)				
	single ended		–	170	–	µV
	bridge tied load		–	350	–	µV
Logic gain control						
ΔG_v	reduction of voltage gain	V_i = 1.8 mV(RMS)				
	GSC2 = 0, GSC1 = 1		5.8	6.3	6.8	dB
	GSC2 = 1, GSC1 = 0		11.7	12.2	12.7	dB
	GSC2 = 1, GSC1 = 1		17	18	19	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Larsen limiter preamplifier						
	operational amplifier					
G_{v0}	open-loop gain		–	92	–	dB
f_{p1}	1st pole		–	120	–	Hz
f_{p2}	2nd pole		–	3.3	–	MHz
G_B	unity gain bandwidth		–	4	–	MHz
G_v	voltage gain	f = 3 kHz; R26 = 10 kΩ; R29 = 4 MΩ	51	52	53	dB
G_v	gain adjustment range		30	–	52	dB
Larsen limiter detector						
	voltage to current convertor					
V_{DCA}-V_{DTI}	DC offset voltage	$V_{BB} - V_{DTI}$ = 1 V	–25	1	+25	mV
G_v	voltage gain from DTI to DCA	V_{DTI} = 100 mV(RMS); f = 3 kHz	tbf	–0.8	tbf	dB
V_{THL1}	DC voltage at THL1	R35 = 51 kΩ	1.8	1.25	1.33	V
V_{THL2}	DC voltage at THL2	R34 = 100 kΩ	1.8	1.25	1.33	V
	dynamic behaviour with a burst at DTI	f = 3 kHz; see Fig.15				
t_{LIr}	listen-in release time	see Fig.15(a)	tbf	40	tbf	ms
t_{ad}	attack delay time	see Fig.15(b)				
	V_{DTI} jumps from 0 to 100 mV (RMS value)		–	160	200	ms
	V_{DTI} jumps from 0 to 1 V (RMS value)		100	120	–	ms
t_{LAa}	Larsen attack time	see Fig.15(b); V_{DTI} = 100 mV(RMS)	–	20	tbf	ms
t_{LAr}	Larsen release time	see Fig.15(b)				
	V_{DTI} jumps from 100 mV to 0 mV (RMS value)		tbf	250	tbf	ms
V_{LLC}	DC voltage at LLC	V_{DTI} = 0 V	1.75	1.9	2.0	V
$-\Delta V_{LLC}$	reduction of V_{LLC} to attack Larsen mode		0.59	0.63	0.68	V
ΔG_v	gain reduction	V_{LLC} = 0.7 V	60	tbf	tbf	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
MUTE input; TEA1085						
	(toggle function, positive edge triggered set-reset flip-flop)					
V_{IL}	LOW level input voltage		0	–	0.3	V
V_{IH}	HIGH level input voltage		1.5	–	$V_{BB} + 0.4$	V
I_{MUTE}	input current	MUTE = LOW	–	–22	–28	µA
t_W	minimum input pulse width		–	50	–	µs
P_R	minimum pulse repetition time		–	2	–	ms
$V_{BB(MUTE)}$	supply voltage below which MUTE toggle is reset		tbf	2	tbf	V
ΔG_v	reduction of gain from LSI1, LSI2 to QLS1, QLS2	MUTE = ON	60	100	–	dB
MUTE input; TEA1085A						
V_{IL}	LOW level input voltage		0	–	0.3	V
V_{IH}	HIGH level input voltage		1.5	–	$V_{BB} + 0.4$	V
I_{MUTE}	input current	MUTE = HIGH	–	10	20	µA
ΔG_v	reduction of gain from LSI1, LSI2 to QLS1, QLS2	MUTE = HIGH	60	100	–	dB
Power down input						
V_{IL}	LOW level input voltage		0	–	0.3	V
V_{IH}	HIGH level input voltage		1.5	–	$V_{BB} + 0.4$	V
I_{PD}	input current	PD = HIGH	–	2.3	2.8	µA
Logic inputs GSC1 and GSC2						
V_{IL}	LOW level input voltage		0	–	0.3	V
V_{IH}	HIGH level input voltage		1.5	–	$V_{BB} + 0.4$	V
I_{GSC}	input current	GSC = HIGH	–	6	8	µA

Notes

1. Typical output power is 5 mW into 50 Ω
2. Typical output power is 20 mW into 50 Ω
3. Typical output power is 40 mW into 50 Ω



(1) To TEA1060 (SLPE)

The DC current is divided as follows:

$$I_{SUP} = I_{IN} - \frac{V_{SUP-SREF}}{R20}$$

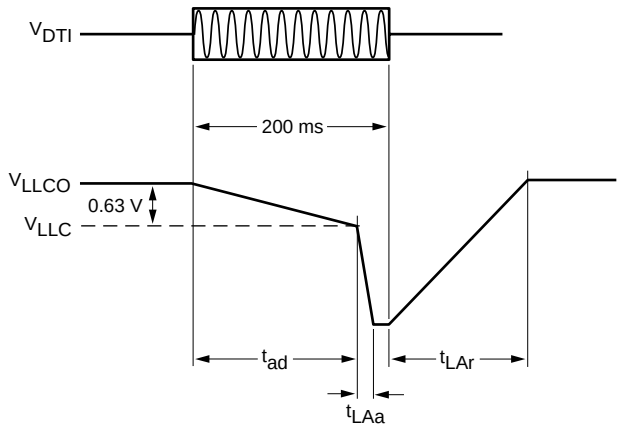
$$I_{LN} = \frac{V_{SUP-SREF}}{R20}$$

The pins not shown in the TEA1060 are left open. An impedance in series with pin SUP (e.g. an ammeter) should be avoided as it interferes with the value of I_{LN}.

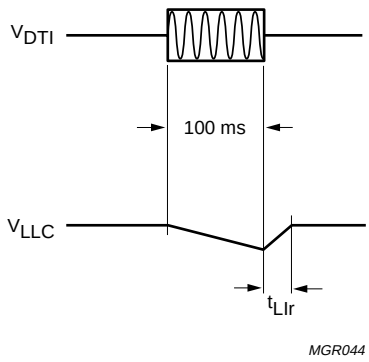
Fig.14 Test circuit.

Table 2 Component values in test circuit Fig.14

COMPONENT	CONDITION	VALUE	UNIT
Resistor			
R1		620	Ω
R5		3.6	kΩ
R9		20	Ω
R20		150	Ω
R25		10	kΩ
R26		10	kΩ
R27		8	MΩ
R28		8	MΩ
R29		4	MΩ
R30		100	kΩ
R31		220	kΩ
R32		100	kΩ
R33		500	Ω
R34		100	kΩ
R35		51	kΩ
R36		120	kΩ
Capacitor			
C1		100	µF
C3		4.7	µF
C20		470	µF
C21		68	pF
C22		2.2	µF
C23		2.2	µF
C24		100	nF
C25		330	nF
C26		1	µF
C27		220	µF
C28		330	nF
C31	TEA1085 only	10	nF



(b) Attack delay (t_{ad}), Larsen attack time (t_{LAa}), Larsen release time (t_{LAr});
V_{DTI} = 100 mV(RMS) and 1 V(RMS); f = 3 kHz.



(a) Listen-in release time (t_{LIr});
V_{DTI} = 100 mV(RMS); f = 3 kHz.

Fig.15 Test signals for Larsen level limiter.

APPLICATION INFORMATION

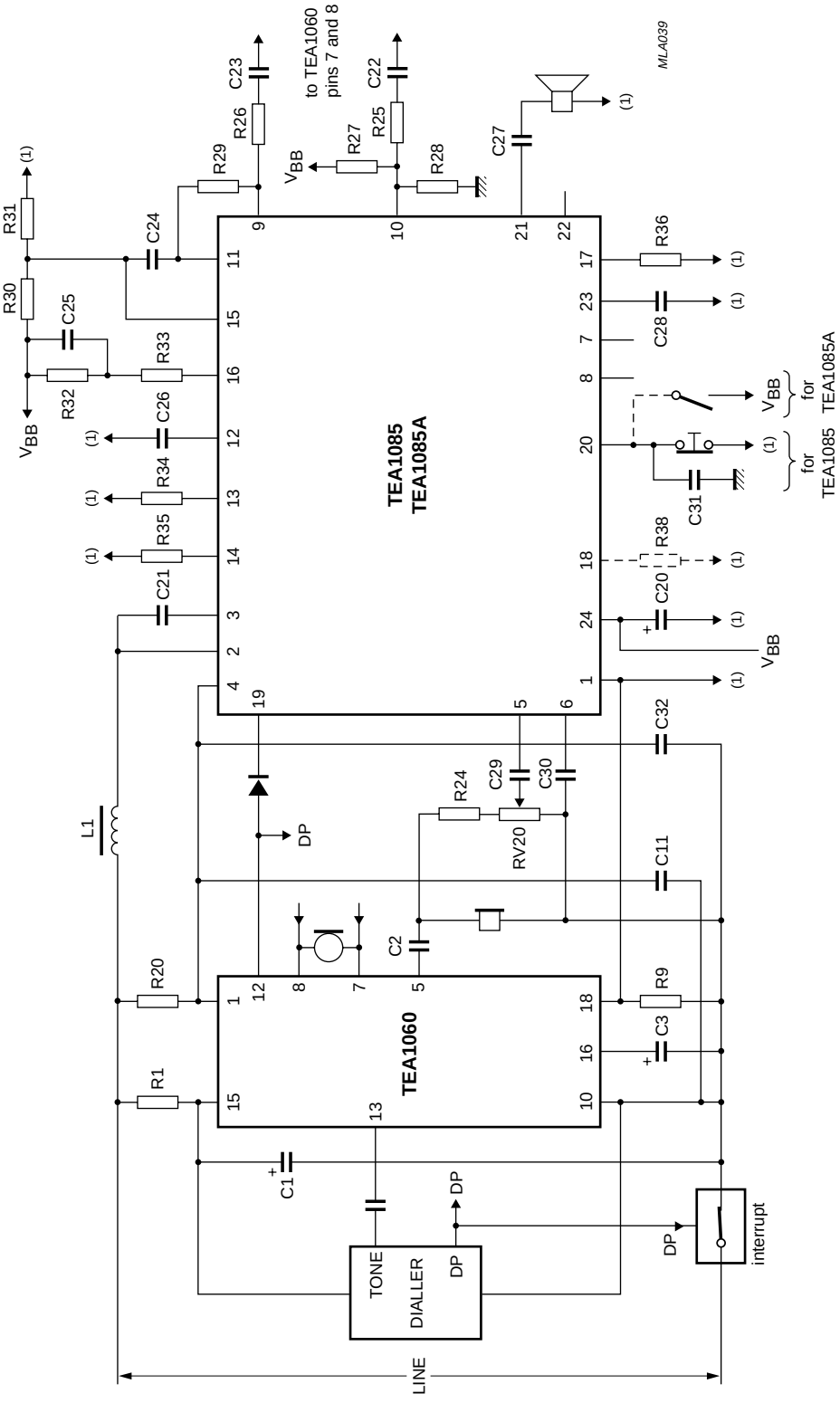


Fig.16 Basic application of TEA1085/TEA1085A and TEA1060.

The basic application circuit of the TEA1085/TEA1085A is illustrated in Fig.16. Only the most important components of the TEA1060 part are shown, other components and their values are given in the TEA1060 Data sheet.
The supply pin (V_{BB}) of the TEA1085/TEA1085A can also be used to supply peripheral circuits (e.g. microcontrollers, diallers etc.). Further information will be published in the TEA1085 application report.

Table 3 Component values in application circuit Fig.16

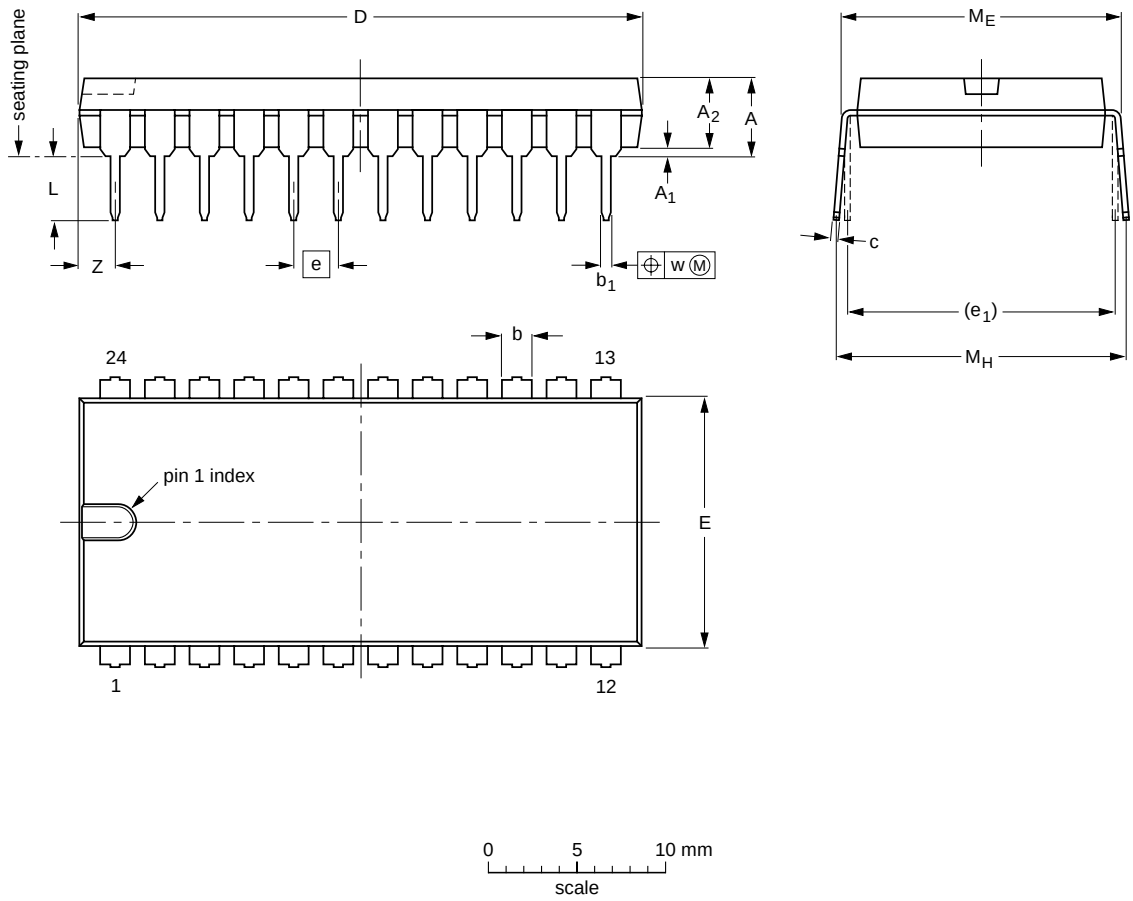
COMPONENT	CONDITION	VALUE	UNIT
Resistor			
R20		150	Ω
R24	note 1	1	kΩ
R25		10	kΩ
R26		10	kΩ
R27	note 1	3.3	MΩ
R28	note 1	3.3	MΩ
R29	note 1	1.65	MΩ
R30		100	kΩ
R31		220	kΩ
R32		100	kΩ
R33		500	Ω
R34		100	kΩ
R35		51	kΩ
R36		120	kΩ
RV20	note 1	1	kΩ
Capacitor			
C11		4.7	nF
C20		470	µF
C21		47	pF
C22		4.7	nF
C23		4.7	nF
C24		4.7	nF
C25		330	nF
C26		1	µF
C27		47	µF
C28		330	nF
C29		220	nF
C30		220	nF
C31	TEA1085 only	10	nF
Coil			
L1		150	µH

Note

1. Value depends on the gain setting of the transmission circuit.

PACKAGE OUTLINES

DIP24: plastic dual in-line package; 24 leads (600 mil) **SOT101-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

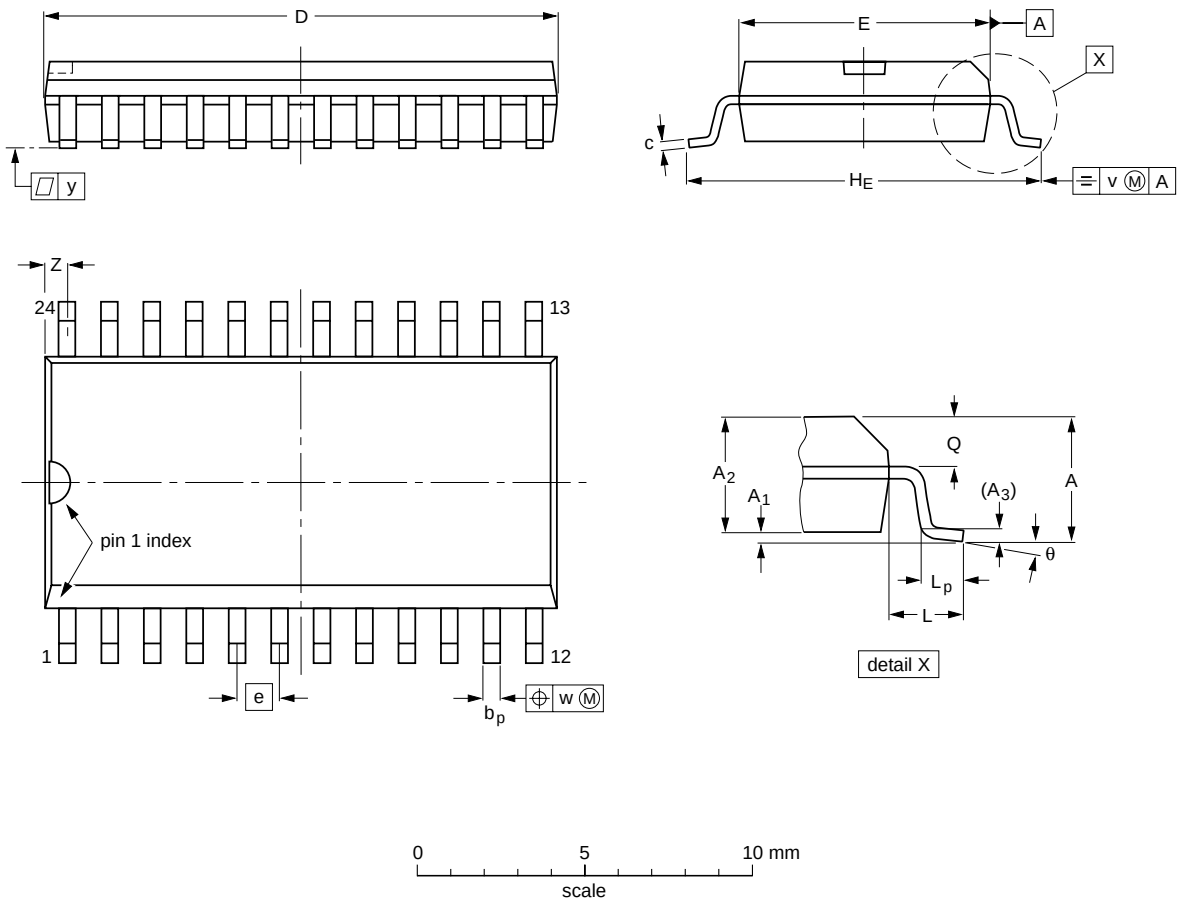
UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	5.1	0.51	4.0	1.7 1.3	0.53 0.38	0.32 0.23	32.0 31.4	14.1 13.7	2.54	15.24	3.9 3.4	15.80 15.24	17.15 15.90	0.25	2.2
inches	0.20	0.020	0.16	0.066 0.051	0.021 0.015	0.013 0.009	1.26 1.24	0.56 0.54	0.10	0.60	0.15 0.13	0.62 0.60	0.68 0.63	0.01	0.087

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT101-1	051G02	MO-015AD				~~92-11-17~~ 95-01-23

SO24: plastic small outline package; 24 leads; body width 7.5 mm **SOT137-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D (1)	E (1)	e	H_E	L	L_p	Q	v	w	y	Z (1)	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	15.6 15.2	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8^o 0^o
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.61 0.60	0.30 0.29	0.050	0.419 0.394	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT137-1	075E05	MS-013AD				~~95-01-24~~ 97-05-22

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (order code 9398 652 90011).

DIP

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\ max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

SO

Reflow soldering

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

Wave soldering

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

Repairing soldered joints

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

NOTES

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NOTES

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Printed in The Netherlands 415102/00/02/pp32 Date of release: March 1992 Document order number: 9397 750 nnnnn

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